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Report No. FAA-RD-77-185

DISCRETE ADDRESS BEACON SYSTEM (DABS) DEVELOPMENT TEST AND EVALUATION (DT&E) PROGRAM

December 1977

FINAL REPORT

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Systems Research & Development Service
Washington, D.C. 20590

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FAA-RD-77-185		

4. Title and Subtitle	5. Report Date
Discrete Address Beacon System (DABS) Development Test and Evaluation (DT&E) Program.	December 1977
	6. Performing Organization Code: ARD-240
	8. Performing Organization Report No.: FAA-RD-77-185
7. Author(s): John J. Wojciech	
9. Performing Organization Name and Address: Department of Transportation, Federal Aviation Administration, Systems Research and Development Service, Washington, DC 20590	10. Work Unit No. (TRAIS): Project No. 034-241
	11. Contract or Grant No.
12. Sponsoring Agency Name and Address: Department of Transportation, Federal Aviation Administration, Systems Research and Development Service, Washington, DC 20590	13. Type of Report and Period Covered: Final rept.
	14. Sponsoring Agency Code: ARD-240

15. Supplementary Notes

16. Abstract

The program to accomplish the Development Test and Evaluation (DT&E) of the Discrete Address Beacon System (DABS) is defined. The goals of the DABS DT&E Program are to establish the DABS performance characteristics, determine the compatibility of DABS with the Air Traffic Control (ATC) system, and demonstrate the ATC performance improvements made possible by DABS. In addition, an evaluation of the Automatic Traffic Advisory and Resolution Service (ATARS) and the use of the DABS data link to exchange pilot-ATC information will be performed. The evaluations of the DABS test results will be used to prepare technical data packages for DABS procurement by the Operating Services.

The DABS DT&E Program consists of four phases: factory acceptance tests, field acceptance tests, performance tests, and DABS/ATC systems tests. General information is provided on the test requirements associated with each program phase, documentation requirements, organizational responsibilities, and schedules.

17. Key Words	18. Distribution Statement
DABS Acceptance Testing DABS Performance Testing DABS/ATC Systems Testing	Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	31	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

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METRIC CONVERSION FACTORS

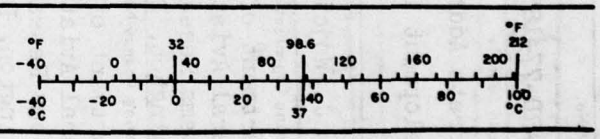
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

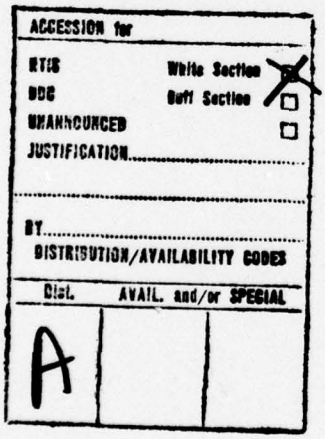
Approximate Conversions from Metric Measures

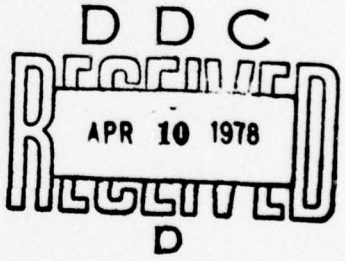
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



PREFACE

This document was coordinated through the DABS Development Test and Evaluation (DT&E) Advisory Group established by the Systems Research and Development Service to assist in the management of the DABS DT&E Program. The group is made up of representatives from the Systems Research and Development Service, National Aviation Facilities Experimental Center, Office of Systems Engineering and Management, Airway Facilties Service, Air Traffic Service, MITRE-METREK, and MIT Lincoln Laboratory. The author would like to express his appreciation to the group members, especially, Messrs. R.W. Lautenschlager and P.R. Purcell, MITRE-METREK, for their assistance in the preparation of the document.





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1.0 INTRODUCTION

1.1 Purpose and Scope

The purpose of this document is to define the overall Discrete Address Beacon System (DABS) Development Test and Evaluation (DT&E) Program. The test requirements associated with each phase of the DT&E Program are provided along with documentation requirements, organizational responsibilities and schedules.

1.2 Background

In 1972, MIT Lincoln Laboratory, Lexington, Mass., was awarded a contract as the DABS System Engineering Contractor (SEC) and tasked to carry out a detailed system design for the DABS. The results of extensive flight testing at Lincoln's DABS Experimental Facility (DABSEF) demonstrated the feasibility of the DABS concept in a single sensor configuration. In addition, the feasibility of the Automatic Traffic Advisory and Resolution Service (ATARS) function to provide traffic advisories and resolution advisories to test aircraft was demonstrated. Throughout these tests, the DABS data link was shown to be an effective means of air-ground communications. In conjunction with this activity, the Engineering Requirements (ER) specified in Reference 1 were prepared for the development of a DABS sensor capable of communicating with other DABS sensors to form a multisensor configuration.

In February 1976, Texas Instruments, Inc., was selected as the DABS Sensor Development Contractor (SDC). Three DABS engineering models are currently being fabricated at the SDC's Plano, Texas, plant and will be installed at or near the National Aviation Facilities Experimental Center (NAFEC), Atlantic City, New Jersey.

The first sensor delivered will be situated at NAFEC and collocated with an ASR-7 radar. The second sensor will be collocated with an ASR-8 radar in Clementon, New Jersey. This site is approximately 13 nmi from the Philadelphia International Airport. The third sensor will be collocated with an ARSR-2, near NAFEC, at Elwood, New Jersey.

The sensors will be interfaced with the NAS En Route and ARTS III test facilities located at NAFEC. The sensors will then be interconnected to form a multisensor configuration.

The evaluations of the DABS test results will be used by the Systems Research and Development Service (SRDS) to prepare technical data packages (TDP) in support of DABS procurement by the Operating Services. The DABS single-sensor TDP is scheduled for completion by April 1980 followed by a DABS multisensor TDP in April 1982. Details of the DABS development program are provided in Reference 2.

2.0 PROGRAM DESCRIPTION

2.1 Program Objectives

The primary objectives of the DABS DT&E Program are to:

1. Establish the DABS surveillance, communications (including data link) and performance monitoring characteristics in both a single sensor and multisensor configuration.
2. Determine the compatibility of DABS with the Air Traffic Control (ATC) system and demonstrate the ATC performance improvements made possible by DABS.
3. Evaluate ATARS and the use of the DABS data link to exchange pilot-ATC information.

2.2 Program Phases

The DABS DT&E Program has been organized into the following phases:

Factory Acceptance Tests

Field Acceptance Tests

Performance Tests

DABS/ATC Systems Tests

The SDC is responsible for performing factory and field (NAFEC) acceptance tests to verify compliance with the DABS Engineering Requirements. Following single sensor testing at the factory,

multisensor operation and those aspects of single sensor operation which cannot be tested in the factory environment will be verified at NAFEC.

NAFEC will conduct extensive tests to comprehensively evaluate DABS system-level functional performance under various expected field-use environments. NAFEC will also use the NAS En Route and ARTS III test facilities to evaluate the DABS data processing characteristics of the ATC software currently being developed and the interactions with the Air Traffic Controller. Initial emphasis will be on the conduct of single sensor tests.

As the test results generated during each of the phases become available, they will be evaluated by the various organizations participating in the DABS DT&E program. This continuing evaluation process will facilitate TDP preparation and provide ATC system planners and users with DABS performance and field implementation guidance prior to the completion of the entire DT&E Program.

3.0 TEST REQUIREMENTS

Summaries of the test requirements associated with the DABS DT&E Program phases are provided below along with general information on the conduct of the tests.

3.1 Factory Acceptance Tests

3.1.1 General

The purpose of the factory acceptance tests is to verify compliance of the DABS equipment with the ER. This equipment includes the DABS sensors, the modified ASR-7 and ASR-8 antennas and back-to-back ARSR antenna, and support equipment. Tests which cannot be conducted at the factory (e.g. DABS/ATC interface and multisensor tesing) will be deferred to the field acceptance test phase.

Factory acceptance testing of the DABS sensor will start at the unit (e.g., transmitter, receiver, processor) level. Following acceptable performance, units will be integrated to form the interrogator and processor, computer and communications, and software subsystems. All SDC unit and subsystem test plans and procedures will be reviewed by the FAA.

Following subsystem verification, system-level testing to determine acceptability of overall DABS functional performance

characteristics will be performed. The FAA will participate in the development of the SDC's system-level test plans and procedures and will provide final approval of this documentation.

The FAA will have the opportunity to witness testing at all levels. The SDC will provide copies of all data collected and prepare a final report on the factory acceptance testing.

The SDC will be responsible for providing internal hardware and software probes, general test equipment, and related data recording, reduction, and analysis tools. The FAA will furnish a DABS transponder, Aircraft Reply and Interference Environment Simulator (ARIES), ATARS benchmark tapes, and Calibration Performance Monitor Equipment (CPME).

3.1.2 Test Requirement Summary

The characteristics of the delivered DABS equipment which will be evaluated in accordance with the DABS ER include the following:

1. Unit and Subsystem Functions
    a. Antenna
    b. Modulator
    c. Transmitter
    d. Receiver
    e. DABS and ATCRBS Reply Processors
    f. ATCRBS Reply-to-Reply Correlation
    g. Channel Management
    h. Surveillance Processing

i. Data Link Processing

j. Network Management

k. ATARS Processing

l. Surveillance and Communications

m. Performance Monitoring

2. System Functions

a. Surveillance (DABS and ATCRBS)

b. Communications (DABS-Aircraft, DABS-ATC, DABS-DABS)

c. ATARS

d. Performance Monitoring

e. System Reliability and Maintainability

f. Failure Recovery (Data Preservation)

g. System Calibration, Start-up and Operation

3. Support Functions

a. Maintenance Display

b. System Test Console (STC)

c. Test Target Generator (TTG)

d. Data Extraction, Recording, and Analysis

e. Program Support Equipment (PSE)

3.2 Field Acceptance Tests

3.2.1 General

The purpose of the field acceptance tests is to complete those single sensor tests which could not be conducted at the factory

and to verify compliance of DABS multisensor operation with the ER.

The SDC, in close cooperation with NAFEC, will install each DABS sensor and interconnect the antenna, search radar digitizer, NAS En Route or System Support Facility (SSF), ARTS III or Terminal Automation Test Facility (TATF), and other sensors. Sufficient testing will then be performed on all delivered equipment to assure that the performance established at the factory has not been degraded as a result of packing, shipping or installation.

The SDC will prepare field acceptance test plans and procedures for approval by the FAA. The FAA will witness the tests and be given copies of all the data collected. The SDC will prepare a final report of the field acceptance tests which, together with the factory acceptance test report, will be the basis for FAA acceptance of the DABS sensors and associated equipment.

The FAA is currently developing software for the TATF and SSF to test the surveillance and communications interfaces between the DABS sensors and the TATF and SSF. The design requirements for this software are given in Reference 3. In addition, the FAA will provide controlled DABS and ATCRBS aircraft of various types, aircraft position measurement systems, a CPME at each site, and the ARIES at two sites. The SDC will be responsible for all other hardware and software tools necessary to verify the acceptability of the DABS equipment.

3.2.2 Test Requirement Summary

The characteristics of the installed DABS equipment which will be evaluated in accordance with the DABS ER include the following:

1. Interfaces between DABS and modified antenna, CPME, search radar digitizer, ATC test facilities (TATF and SSF), and other sensors.
2. DABS and ATCRBS target coverage, detection, and accuracy.
3. Multisensor operation (including STC).

3.3 Performance Tests

3.3.1 General

Following the acceptance of the DABS sensors by the FAA, NAFEC will conduct extensive live and simulated flight tests to evaluate the system-level functional performance characteristics of DABS. Deficiencies in performance will be documented and, where conditions warrant, DABS design changes will be implemented.

Live targets will be provided by targets-of-opportunity as well as DABS-equipped NAFEC aircraft and rental aircraft of various types. The ARIES will be used to provide simulated traffic. Precision aircraft tracking systems located at NAFEC will be used to provide independent position measurement data.

Extensive use will be made of the STC located at the NAFEC site to monitor and control test activities, record data received and transmitted between the sensors and ATC facilities, and generate ATC to DABS messages. Other major test support items include the search radar digitizer, the TATF and SSF with associated DABS interface verification software, various SDC and NAFEC computer programs for performing data reduction and analysis, and computer performance measurement hardware and/or software.

Performance testing will initially concentrate on single sensor operation. Both the overlapping and nonoverlapping DABS coverage conditions will be addressed.. Multisensor (i.e. when two or more DABS sensors are communicating with each other) performance will be conducted following the single sensor tests. More detailed DABS performance test requirements are provided in Reference 4.

Initial ATARS testing will concentrate on Automatic Traffic Advisory Service (ATAS) performance in a single-sensor environment. Various algorithm parameters and cockpit display characteristics will be evaluated. ATARS resolution performance will be evaluated in detail during multisensor testing.

3.3.2 Test Requirement Summary

The system-level functional performance characteristics which will be evaluated under various expected field-use environments include the following:

1. Surveillance (DABS and ATCRBS)
    a. Accuracy and Resolution
    b. Coverage and Dissemination
    c. Capacity and Response Time
    d. Detection Probability and False Targets
    e. Radar/Beacon Correlation and Collimation
    f. Multisensor Registration
    g. Sensor Tracking
2. Communications (DABS-Aircraft, DABS-ATC, DABS-DABS)
    a. Message Delivery Probability
    b. Error Rate
    c. Capacity and Response Time
3. ATARS
    a. Traffic Advisory Integrity
    b. Resolution Advisory Integrity
    c. False Alarms
    d. Capacity and Response Time
    e. Pilot/System Interface
4. Performance Monitoring (Includes CPME)
    a. Fault Detection Probability
    b. Response Time
5. Failure Recovery (Data Preservation)
    a. Recovery Probability
    b. Response Time

6. Computer Performance
   a. Data Integrity
   b. TILINE Contention
   c. Task Execution Profile
   d. Busy Time
7. Reliability and Maintainability
   a. Mean-Time-Between-Failure (MTBF)
   b. Failure Modes
   c. Corrective Maintenance

3.4 DABS/ATC Systems Tests

3.4.1 General

NAFEC will conduct extensive tests to evaluate the utilization of DABS surveillance and communications (including data link) capabilities by NAS En Route and ARTS III ATC facilities. In addition to DABS compatibility determination, the DABS/ATC systems tests will be designed to demonstrate the ATC performance improvements made possible by DABS. An engineering evaluation of the technical performance characteristics will be performed followed by an evaluation of operational performance by Air Traffic Controllers.

The ARIES will be used to provide simulated traffic with some live flights to verify simulation results. The SSF will be adapted to simulate the New York En Route Center and the TATF will be adapted to simulate the Philadephia Terminal. Air

Traffic Controllers from both NAFEC and field ATC facilities will participate in the operational testing.

The DABS/ATC systems testing will require the development of SSF and TATF software. Initial emphasis will be on the processing of DABS surveillance data including the necessary changes to ATC tracking to take advantage of the more accurate and reliable target reports expected from a DABS sensor. Preliminary design requirements for surveillance-related ATC software are provided in Reference 5. Software development will then focus on processing communications messages between ATC and DABS and between the pilot and ATC via the DABS data link.

DABS/ATC systems testing will be performed using the single-sensor and multisensor (i.e. when 2 or more DABS sensors are communicating with each other) DABS configurations. Deficiencies in performance will be documented and, where conditions warrant, DABS or ATC design changes will be implemented.

3.4.2 Test Requirement Summary

3.4.2.1 Technical Performance

The DABS/ATC system technical performance characteristics which will be evaluated under various expected field-use environments include the following:

1. Surveillance

   a. Reports

      (1) Accuracy and Resolution

      (2) Lost or False Targets

      (3) Capacity and Response Time

      (4) Coverage and Dissemination

   b. Tracking

      (1) Initiation and Continuity

      (2) Accuracy

      (3) Swaps and False Tracks

      (4) Capacity

   c. Upgraded-Third Generation ATC Support

2. Communications

   a. Equipment Status and Control

   b. ATARS

      (1) Traffic Advisories

      (2) Resolution Advisories

   c. Pilot-ATC Information

      (1) Pilot-Originated

      (2) ATC-Originated

3.4.2.2 Operational Performance

The DABS/ATC system operational performance characteristics which will be evaluated under various expected field-use environments include the following:

1. **Surveillance**
    a. **Data Integrity**
    b. **Control Procedures**
    c. **Controller/System Interface**
2. **Communications**
    a. **Data Integrity**
    b. **Utilization Procedures**
    c. **Controller/System Interface**

4.0 DOCUMENTATION REQUIREMENTS

This section defines guidelines for preparing the documents required during each phase of the DABS DT&E Program. This documentation includes test plans, procedures, and reports and plans for configuration control. The documents will be prepared by the organization responsible for the testing.

4.1 Test Plans

The test plans will indicate how the various test requirements listed in this document will be satisfied. For each category of tests to be performed, information will be provided on the following: test objectives, prerequisites, measurement variables, test conditions, instrumentation requirements, data reduction and analysis methods, test reporting, and any special support requirements such as tape scenarios. The plans will also provide a schedule for the preparation of test procedures and reports.

4.2 Test Procedures

The procedures for conducting the prescribed tests and obtaining the necessary data will be prepared. Test procedures will address the following: DABS hardware and software operation, activities of test personnel, instrumentation operation, data recording instructions including samples of the data sheets, and data reduction and analysis procedures.

4.3 Test Reports

Test reports will generally describe or refer to the test configurations and scenarios, discuss data handling procedures and analysis assumptions, summarize the results and highlight problem areas. All test data will be made available to the organizations participating in the DABS DT&E Program.

4.4 Configuration Control Plan

The software and hardware used throughout the DABS DT&E program tests will be subject to changes which reflect improvements, alternate approaches or test bed variations. In order to permit a meaningful comparision of results obtained from different tests, control must be exercised over the test bed configuration to include the ATC system used in the DABS DT&E. This requires a well documented test bed baseline and the establishment and maintenance of procedures to classify, review, coordinate and approve changes to the test bed baseline.

5.0 ORGANIZATIONAL RESPONSIBILITIES

5.1 Systems Research and Development Service

5.1.1 Communications Division, ARD-200

The responsibility for managing the DABS Development Program has been assigned to the Surveillance Branch, ARD-240. This activity includes the development of the overall DABS engineering models, coordination of the DABS Development Test and Evaluation (DT&E) Program, and preparation of DABS technical data packages for the Operating Services. With respect to the DT&E Program, ARD-240 will define the Program (this document), allocate program resources, monitor and coordinate program activities, approve test plans and design change requests, and evaluate the test results. Close coordination will be required between ARD-240 and the Systems Engineering Branch, ARD-230, and the Separation Assurance Branch, ARD-250, regarding data link and ATARS DT&E activities, respectively.

5.1.2 Air Traffic Control Systems Division, ARD-100

ARD-100 is responsible for providing the necessary en route and terminal ATC software and hardware to support the field acceptance testing of the DABS/SSF and DABS/TATF surveillance and communications interfaces and the DABS/ATC systems testing. In addition, ARD-100 will assist in the test coordination, review the test plans, evaluate the results, and modify the ATC hardware and software as appropriate. The results of the DABS/ATC testing

will be used by ARD-100 to prepare a TDP for ATC operational software compatible with DABS.

5.2 National Aviation Facilities Experimental Center

The major FAA portion of the DABS DT&E Program will be performed by the Surveillance Systems Branch, ANA-120. The NAFEC effort is broken down into two areas, i.e, establishment and maintenance of the 3-sensor test bed and the planning and conduct of the performance and DABS/ATC systems testing. In addition, ANA-120 will support sensor development and field installation, acceptance tests, ATC software development, DABS and ATC design improvements and configuration control, and evaluation of test results.

5.3 MITRE-METREK

MITRE-METREK has been tasked by ARD-200 to support the development of the DT&E Program, review of the SDC and NAFEC test plans, monitoring of SDC and NAFEC test activities, and evaluation of test results. MITRE-METREK is also supporting ARD-100 in the preparation of the DABS/ATC system test software specifications and software test requirements.

5.4 MIT Lincoln Laboratory

MIT Lincoln Laboratory is responsible for supporting sensor development, test, and evaluation activities at the factory and NAFEC. In addition Lincoln is developing the ARIES and CPME.

5.5 DABS DT&E Advisory Group

An advisory group has been established by SRDS to assist in the management of the DABS DT&E Program. Specifically, this group will assist in the establishment and implementation of the DABS DT&E Program, review test documentation, review and propose design changes, monitor test status and resource utilization, and evaluate the test results. The group is made up of representatives from SRDS, NAFEC, Office of Systems Engineering and Management, Airway Facilities Service, Air Traffic Service, MITRE-METREK, and MIT Lincoln Laboratory.

5.6 ARD 100/200 DABS/ATARS/ATC Automation Configuration Control Working Group

The function of this group is to establish and maintain configuration identification, control and accounting of the DABS and ATARS interfaces with the ATC Automation System. Participating with ARD-100 and ARD-200 are representatives from NAFEC, MITRE-METREK, and MIT Lincoln Laboratory.

6. SCHEDULES

6.1 Testing

The testing associated with the DABS DT&E Program phases will be completed as follows:

Factory Acceptance Tests	December 1978
Field Acceptance Tests	March 1979
Performance Tests	
Single-Sensor	March 1980
Multisensor	March 1982
DABS/ATC Systems Tests	
Single-Sensor	March 1980
Multisensor	January 1982

6.2 Test Plans

Draft copies of the test plans described in section 4.1 will be submitted as follows:

Acceptance Tests (Factory/Field)	January 1978
Performance Tests	
Single-Sensor	April 1978
Multisensor	September 1979
DABS/ATC Systems Tests	
Single-Sensor	October 1978
Multisensor	June 1980

6.3 Performance Evaluations

The evaluation of DABS test results will begin as soon as the factory test reports become available and continue through the last NAFEC report. These evaluations, which will be performed jointly by the organizations participating in the DABS DT&E Program, will be used to prepare the DABS technical data packages. A preliminary evaluation of DABS single-sensor performance will be available by September 1979. The final evaluation will be completed in April 1980. The final evaluation of DABS multisensor performance is scheduled for April 1982.

APPENDIX

REFERENCES

1. The following Department of Transportation, Federal Aviation Administration, Engineering Requirements (ER) as revised:

   a. FAA-ER-240-25, Discrete Address Beacon System (DABS) Facilities and Support Services

   b. FAA-ER-240-26, Discrete Address Beacon System (DABS) Sensor

   c. FAA-ER-240-31, ASR-7 Antenna Modification

   d. FAA-ER-240-32, ASR-8 Antenna Modification

   e. FAA-ER-240-34, DABS System Test Console

   f. FAA-ER-240-35, Antenna Group, En Route DABS/ATCRBS, Array

2. FAA-ED-03-1, Engineering and Development Plan - Discrete Address Beacon System (DABS)

3. The following Federal Aviation Administration Functional Design Specifications:

   a. En Route Interface Verification Software for the Discrete Address Beacon System (DABS)

   b. Terminal Interface Verification Software for the Discrete Address Beacon System (DABS)

4. FAA-RD-76-147, "Performance Test Requirements for the Discrete Address Beacon System (DABS) Engineering Models", R.W. Lautenschlager and P.R. Purcell, MITRE-METREK, September 1976.

5. The following MITRE-METREK Preliminary Software Design Requirements:

   a. MTR-7577, "Terminal Software Requirements for Processing DABS Surveillance Data", H. Gabrieli, July 1977.

   b. MTR-7712, "Terminal Software Requirements for Processing Surveillance Related DABS Communications Data", P.R. Purcell, February 1978.

c. MTR-7423, "Preliminary Functional Specification: En Route Automatic Tracking for the DABS/ATCRBS Surveillance Environment", H. Gabrieli and R. Lefferts, February 1977.

d. MTR-7299, "Preliminary Functional Specification: En Route Multiple Radar Data Processing (MRDP) for the DABS/ATCRBS Surveillance Environment", R. Lautenschlager and D. Miskill, March 1977.

e. MTR-7507, "Functional Design Specification: En Route Computer Program Protocol for the DABS-FEP/SSF Interface", S.J. Hauser and J.S. Held, July 1977.

f. MTR-7615, "Preliminary Functional Specification: Central Computer Complex Input/Output for the DABS/ATCRBS Surveillance Environment", J.S. Held, October 1977.